Raymond D. Brigham, USA

VARIABILITY FOR YIELD AND BIOCHEMICAL CONSTITUENTS IN SELECTED HYBRIDS AND OPEN-POLLINATED VARIETIES OF SUNFLOWER IN TEXAS

Commercial production of oilseed sunflower hybrids began in 1974 in the Lubbock, Texas, area. Approximately 2025 hectares (5000 acres) were grown under irrigation that year. In 1975, approximately 141,750 hectares (350,000 acres) were planted. About 90% of the acreage was seeded to Romsun 52, and 10% was seeds to hybrids using parents produced in USA breeding programs.

A replicated yield trial of 15 hybrids and 3 open pollinated varieties was grown under irrigation at the Texas Agricultural Experiment Station, Lubbock, Texas in 1975. Hybrid entries included Romsun 52, Romsun 53, (utilizing generic females) and 13 commercial or experimental hybrids utilizing cytoplasmic male sterile female lines. Open-pollinated entries included Peredovik, Sputnik, and Sundak, a non-oil variety. Four-row plots, 7.6 meters in length and replicated 4 times, were seeded April 21, irrigated June 21 and July 14, and hand harvested in early September.

Yields of open-pollinated varieties were generally below yields of hybrids (Table 1). The 15 hybrids averaged 2926 kg/ha (2610 lb/acre), compared to 2615 kg/ha (2333 lb/acre) for the 3 open-pollinated varieties, an average increase of 12%. The highest yielding hybrid produced 3344 kg/ha (2983 lb/acre), 22% above the average of the open-pollinated varieties.

The two three-way hybrids (Hybrids 8941 and 8944) were generally lower in yield than single cross hybrids, and also exhibited greater variability in phenotype.

Sunbred 212 was outstanding in seed weight (46.5 kg/hl), but was one of the lowest yielding

hybrids. Romsun 52 and Romsun 53 had significantly lower seed weight than the other oilseed hybrids (36.2 and 36.3 kg/hl, respectively). Sundak, a non-oil type, was lowest of all cultivars in seed weight (32.4 kg/hl).

Oil and protein content was determined using seed samples from each of four replications. Five gram prepared samples were refluxed 6 hours with petroleum ether in Butt extraction apparatus to recover oil. Protein was determined by standard Kjeldahl procedures.

Oilseed hybrids ranged from a high of 50.8 to a low of 40.7% in oil content (Table 2). Sundak, the only non-oil cultivar, averaged 30.5% oil. Hybrids produced in the USA were higher in oil content than Ronsun 52 and 53, with the exception of Hybrid 904. The 13 US hybrids averaged 46.9% oil compared to 42.8% for the average of Romsun 52 and 53. Several of the US hybrids highest in oil content used cmsHA 89 as the female parent, and several lowest in oil used RHA 274 as the male parent. Coefficient of correlation for oil and protein content (means of 18 entries) was -0.369, which is typical of the negative relationship usually found in oilseed crops for oil and protein content.

Fatty acids were determined from oil samples of each replication of each cultivar by using gas-liquid chromatography equipment. Palmitic (16:0), stearic (18:0), oleic (18.1) and linoleic (18.2) fatty acid determinations were carried out (Table 3).

Content of palmitic acid ranged from 6.4 to 5.4%. The coefficient of variation (C.V.) was acceptable for this fatty acid (5.11%). Stearic acid content was more variable (C.V.=11.02%), and ranged from 5.7 to 4.1%.

The oleic and linoleic acid content is of most importance from the standpoint of utilization of sunflower oil for food products. To be acceptable for frying oil and other food uses, 40% or more oleic acid is desirable. Warm

Table 2

Oil and Protein Content of Sunflower Cultivars, Lubbock, Texas, 1975

Cultivar	% Oil Moisture-free basis	% Protein
Sun-Gro 372	50.8*	20.2 de*
Hybrid 896	49.3 ab	19.6 e
Sun-Hi 301	48.9 bc	20.6 cde
Hybrid 201	48.5 bc	21.5 cd
Sunbred 212	48.5 bc	20.9 cde
Hybrid 903	47.8 bc	22.1 bc
Hybrid 8941	47.7 bc	21.7 cd
Sun-Gro 380	47.7 c	21.3 cd
Sputnik	47.2 c	23.5 bc
Hybrid 204	45.3 d	21.2 cd
Hybrid 8944	45.2 d	20.7 cde
Hybrid 893	45.1 d	23.2 ab
Peredovik	45.0 d	24.4 a
Hybrid 894	44.5 de	21.7 cd
Romsun 53	43.2 ef	24.5 a
Romsun 52	42.3 f	24.2 a
Hybrid 904	40.7 g	23.7 a
Sundak	30.5 h	21.6 cd
$\bar{x}$ =	45.5	22.0
C.V. =	2.48%	4.19%

* Means (in the same column) followed by the same letter are not different at the 5% level of significance (Duncan's multiple range test).

Table 3

Fatty Acid Content (%) of Sunflower Cultivars, Lubbock, Texas 1975

Cultivar	16:0 Palmitic*	18:0 Stearic*	18:1 Oleic*	18:2 Linoleic*
Sunbred 212	5.8 cdef**	4.8 bcdef**	41.2 abc**	48.2 fgh**
Sun-Hi 301	6.1 abc	5.1 abcde	37.1 hi	51.7 abc
Sun-Gro 372	6.3 ab	4.8 bcdef	39.6 cde	49.3 efg
Sun-Gro 380	6.2 abc	5.3 abc	36.8 i	51.8 ab
Hybrid 201	5.8 cdef	4.6 cdef	37.2 ghi	52.4 a
Hybrid 204	6.2 abc	4.5 cdef	37.5 fghi	51.9 ab
Hybrid 8941	6.0 abcd	4.3 ef	40.5 bcd	49.4 ef
Hybrid 8944	5.9 bcdef	4.4 cdef	42.0 ab	48.0 fgh
Hybrid 893	5.9 abcdef	5.6 ab	38.9 defg	49.7 def
Hybrid 894	6.4 a	4.4 cdef	38.7 defgh	50.6 bcde
Hybrid 903	5.7 cdef	5.2 abcd	41.5 ab	47.7 gh
Hybrid 904	5.9 abcde	4.4 def	41.0 abc	48.5 fgh
Romsun 52	5.5 def	4.2 f	38.0 efghi	52.3 a
Romsun 53	5.4 f	4.7 bcdef	38.9 defg	51.0 abcd
Hybrid 896	6.0 abcd	4.6 cdef	39.2 def	50.2 cde
Peredovik	5.4 ef		41.1 abc	48.3 fgh

Table 3 (continued)

Cultivar	16:0 Palmitic*	18:0 Stearic*	18:1 Oleic*	18:2 Linoleic*
Sputnik	5.8 bcdef	5.7 a	39.5 cde	49.0 efgh
Sundak	5.9 abcde	4.1 f	42.5 a	47.5 h
$\bar{x}$ =	5.89	4.75	39.50	49.85
C.V. =	5.11%	11.02%	2.78%	2.06%

* Mean of 4 replications

** Means (in the same column) followed by the same letter are not different at the 5% level of significance (Duncan's multiple range test).

temperatures after flowering are apparently important in determining high oleic content of sunflower seed - cool temperatures generally cause reduced oleic acid content. In these cultivars, oleic acid content ranged from 42.5 to 36.8%, and linoleic acid content from 52.4 to 47.5%, with a very low coefficient of variation (2.06%).

Differences among cultivars were significant at the 1% level for both oleic and linoleic acid. A correlation coefficient of -0.50 was calculated for the relationship between oleic and linoleic acid percentage, which is lower than that reported in other research reports.